Specifications

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.
Specifications in *italic* text are guaranteed by design.

Analog input

Table 1. General analog input specifications

Parameter	Condition	Specification
A/D converter type		Successive approximation
ADC resolution		16 bits
Number of channels		8 differential, 16 single-ended Software-selectable
Input voltage range		±10 V, ±5 V, ±2 V, ±1 V Software-selectable per channel
Absolute max input voltage	*CHx relative to AGND*	▪ *±25 V max (power on)* ▪ *±15 V max (power off)*
Input impedance		▪ *1 GΩ (power on)* ▪ *820 Ω (power off)*
Input bias current		*±10 nA*
Input bandwidth	All input ranges, small signal (–3 dB)	RedLab 1608G: 750 kHz RedLab 1608GX: 870 kHz RedLab 1608GX-2AO: 870 kHz
Input capacitance		*60 pf*
Max working voltage (signal + common mode)		±10.2 V max relative to AGND
Common mode rejection ratio	(f_{IN} = 60 Hz, all input ranges)	86 dB
Crosstalk	Adjacent differential mode channels, DC to 100 kHz	–75 dB
Input coupling		DC
Sampling rate		RedLab-1608G: 0.0149 Hz to 250 kHz RedLab 1608GX: 0.0149 Hz to 500 kHz RedLab 1608GX-2AO: 0.0149 Hz to 500 kHz software-selectable
Trigger source		TRIG (see *External trigger* below)
Sample clock source		Internal A/D clock or external A/D clock (AICKI pin)
Burst mode		RedLab 1608G: 4 µs RedLab 1608GX: 2 µs RedLab 1608GX-2AO: 2 µs Software-selectable using the internal A/D clock; always enabled when using the external clock (AICKI pin).
Throughput	Software paced	33 to 4000 S/s typical, system dependent
	Hardware paced	RedLab 1608G: 250 kS/s max RedLab 1608GX: 500 kS/s max RedLab 1608GX-2AO: 500 kS/s max
Channel gain queue	Up to 16 elements	Software-selectable range for each channel
Warm-up time		15 minutes min

Accuracy

Analog input DC voltage measurement accuracy

Table 2. DC Accuracy components and specifications. All values are (±)

Range	Gain error (% of reading)	Offset error (µV)	INL error (% of range)	Absolute accuracy at Full Scale (µV)	Gain temperature coefficient (% reading/°C)	Offset temperature coefficient (µV/°C)
±10 V	0.024	915	0.0076	4075	0.0014	47
±5 V	0.024	686	0.0076	2266	0.0014	24
±2 V	0.024	336	0.0076	968	0.0014	10
±1 V	0.024	245	0.0076	561	0.0014	5

Noise performance

For the peak-to-peak noise distribution test, a differential input channel is connected to AGND at the input terminal block, and 32,000 samples are acquired at the maximum rate available at each setting.

Table 3. Noise performance specifications

Range	Counts	LSBrms
±10 V	6	0.91
±5 V	6	0.91
±2 V	7	1.06
±1 V	9	1.36

Settling time

Settling time is defined as the accuracy that can be expected after one conversion when switching from a channel with a DC input at one extreme of full scale to another channel with a DC input at the other extreme of full scale. Both input channels are configured for the same input range.

Table 4. Input settling time specifications in µS, typical

RedLab 1608GX-2AO, RedLab 1608GX			
Range	**2 µS settling accuracy (% FSR)**	**4 µS settling accuracy (% FSR)**	**9 µS settling accuracy (% FSR)**
±10 V	0.1251	0.0031	0.0015
±5 V	0.0687	0.0031	0.0015
±2 V	0.0687	0.0031	0.0015
±1 V	0.0687	0.0031	0.0015
RedLab 1608G			
Range	**4 µS settling accuracy (% FSR)**	**6 µS settling accuracy (% FSR)**	**±10 µS settling accuracy (% FSR)**
±10 V	0,0061	0.0031	0.0015
±5 V	0,0061	0.0031	0.0015
±2 V	0,0061	0.0031	0.0015
±1 V	0,0061	0.0031	0.0015
±10 V	0,0061	0.0031	0.0015

Analog output (RedLab 1608GX-2AO only)

Table 6. Analog output specifications

Parameter	Condition	Specification
Number of channels		2
Resolution		16 bits
Output ranges	Calibrated	±10 V
Output transient	Host computer is reset, powered on, suspended, or a reset command is issued to the device	Duration: 500 µs Amplitude: 2 V p-p
	Powered off	Duration: 10 ms Amplitude: 7 V peak
Differential non-linearity		±0.25 LSB typical ±1 LSB max
Output current	AOUTx pins	±3.5 mA max
Output short-circuit protection	AOUTx connected to AGND	Unlimited duration
Output coupling		DC
Power on and reset state		DACs cleared to zero-scale: 0 V, ±50 mV
Output noise		30 µVrms
Sample clock source		Internal D/A clock or external D/A clock (AOCKI pin)
Output update rate		500 kHz / (number of channels in scan)
Settling time	*To rated accuracy, 10 V step*	*40 µs*
Slew rate		*9 V/µs*
Throughput	Software paced	33 to 4000 S/s typ, system-dependent
	Hardware paced	500 kS/s max, system-dependent

Note 1: Leave unused AOUTx output channels disconnected.

Note 2: AOUTx defaults to 0 V whenever the host computer is reset, powered on, suspended, or a reset command is issued to the device.

Table 7. Calibrated absolute accuracy specifications

Range	Absolute accuracy (±LSB)
±10 V	16.0

Table 8. Calibrated absolute accuracy components specifications

Range	% of reading	Offset (±mV)	Offset tempco (µV/°C)	Gain tempco (ppm of range/°C)
±10 V	±0.0183	1.831	12.7	13

Table 9. Relative accuracy specifications (±LSB)

Range	Relative accuracy (INL)
±10 V	4.0 typical

Analog input/output calibration

Table 10. Analog input/output calibration specifications

Parameter	Specification
Recommended warm-up time	15 minutes min
Calibration method	Self-calibration (firmware)
Calibration interval	1 year (factory calibration)
AI calibration reference	+5 V, ±2.5 mV max. Actual measured values stored in EEPROM.
	Tempco: 5 ppm/°C max
	Long term stability: 15 ppm/1000 hours
AO calibration procedure (**Error! Unknown document property name.** only)	The analog output pins are internally routed to the analog input circuit. For best calibration results, disconnect any AOUTx connections at the terminal block pins prior to performing AOUT calibration.

Digital input/output

Table 11. Digital input/output specifications

Parameter	Specification
Digital type	CMOS
Number of I/O	8
Configuration	Each bit may be configured as input (power on default) or output
Pull-up configuration	The port has 47 kΩ resistors configurable as pull-ups or pull-downs (default) via internal jumper (W1).
Digital I/O transfer rate (system-paced)	33 to 8000 port reads/writes or single bit reads/writes per second typical, system dependent.
Input high voltage	2.0 V min 5.5 V absolute max
Input low voltage	0.8 V max –0.5 V absolute min 0 V recommended min
Output high voltage	4.4 V min (IOH = –50 µA) 3.76 V min (IOH = –2.5 mA)
Output low voltage	0.1 V max (IOL = 50 µA) 0.44 V max (IOL = 2.5 mA)
Output current	±2.5 mA max

External trigger

Table 12. External trigger specifications

Parameter	Specification
Trigger source	TRIG input
Trigger mode	Software programmable for edge or level sensitive, rising or falling edge, high or low level. Power on default is edge sensitive, rising edge.
Trigger latency	1 µs + 1 clock cycle max
Trigger pulse width	100 ns min
Input type	Schmitt trigger, 33 Ω series resistor and 49.9 kΩ pull-down to ground
Schmitt trigger hysteresis	0.4 V to 1.2 V
Input high voltage	2.2 V min 5.5 V absolute max
Input low voltage	1.5 V max –0.5 V absolute min 0 V recommended min

External clock input/output

Table 13. External clock I/O specifications

Parameter	Specification	
Terminal names	AICKI, AICKO, AOCKI, AOCKO (RedLab 1608GX-2AO only)	
Terminal types	AxCKI: AxCKO:	Input, active on rising edge Output, power on default is 0 V, active on rising edge
Terminal descriptions	AxCKI:	Receives sampling clock from external source
	AxCKO:	Outputs the internal sampling clock (D/A or A/D clock) or the pulse generated from AxCKI when in external clock mode.
Input clock rate	RedLab 1608G: max. 250 kHz RedLab 1608GX: max. 500 kHz RedLab 1608GX-2AO: max. 500 kHz	
Clock pulse width	AxCKI:	400 ns min
	AxCKO:	400 ns min
Input type	Schmitt trigger, 33 Ω series resistor, 47 kΩ pull-down to ground	
Schmitt trigger hysteresis	0.4 V to 1.2 V	
Input high voltage	2.2 V min 5.5 V absolute max	
Input low voltage	1.5 V max –0.5 V absolute min 0 V recommended min	
Output high voltage	4.4 V min (IOH = –50 µA) 3.76 V min (IOH = –2.5 mA)	
Output low voltage	0.1 V max (IOL = 50 µA) 0.44 V max (IOL = 2.5 mA)	
Output current	±2.5 mA max	

Counter

Table 14. Counter specifications

Parameter	Specification
Terminal names	CTR0, CTR1
Number of channels	2 channels
Resolution	32-bit
Counter type	Event counter
Input type	Schmitt trigger, 33 Ω series resistor, 47 kΩ pull-down to ground
Input source	CTR0 (pin 52) CTR1 (pin 51)
Counter read/writes rates (software paced)	33 to 8000 reads/writes per second typical, system dependent
Input high voltage	2.2 V min, 5.5 V max
Input low voltage	1.5 V max, –0.5 V min
Schmitt trigger hysteresis	0.4 V min, 1.2 V max
Input frequency	20 MHz, max
High pulse width	*25 ns, min*
Low pulse width	*25 ns, min*

Timer

Table 15. Timer specifications

Parameter	Specification
Terminal name	TMR
Timer type	PWM output with count, period, delay, and pulse width registers
Output value	Default state is idle low with pulses high, Software-selectable output invert
Internal clock frequency	64 MHz
Register widths	32-bit
High pulse width	*15.625 ns min*
Low pulse width	*15.625 ns min*
Output high voltage	4.4 V min (IOH = –50 µA) 3.76 V min (IOH = –2.5 mA)
Output low voltage	0.1 V max (IOL = 50 µA) 0.44 V max (IOL = 2.5 mA)
Output current	±2.5 mA max

Memory

Table 16. Memory specifications

Parameter	Specification
Data FIFO	4 kS analog input/2 kS analog output
Non-volatile memory	32 KB (28 KB firmware storage, 4 KB calibration/user data)

Power

Table 17. Power specifications

Parameter	Condition	Specification
Supply current (Note 3)	Quiescent current	RedLab 1608G: 230 mA RedLab 1608GX: 260 mA RedLab 1608GX-2AO: 260 mA
+5 V user output voltage range	Available at terminal block pin 42	4.9 V min to 5.1 V max
+5 V user output current	Available at terminal block pin 42	10 mA max

Note 3: This is the total quiescent current requirement for the device that includes up to 10 mA for the Status LED. This does not include any potential loading of the digital I/O bits, +5V terminal, or the AOUTx outputs (RedLab 1608GX-2AO only).

USB

Table 18. USB specifications

Parameter	Specification
USB device type	USB 2.0 (high-speed)
Device compatibility	USB 1.1, USB 2.0
USB cable type	A-B cable, UL type AWM 2527 or equivalent. (min 24 AWG VBUS/GND, min 28 AWG D+/D–)
USB cable length	3 m (9.84 ft) max

Environmental

Table 19. Environmental specifications

Parameter	Specification
Operating temperature range	0 °C to 55 °C max
Storage temperature range	–40 °C to 85 °C max
Humidity	0% to 90% non-condensing max

Mechanical

Table 20. Mechanical specifications

Parameter	Specification
Dimensions (L × W × H)	127 × 89.9 × 35.6 mm (5.00 × 3.53 × 1.40 in.)
User connection length	3 m (9.84 ft) max

Screw terminal connector

Table 21. Screw terminal connector specifications

Parameter	Specification
Connector type	Screw terminal
Wire gauge range	16 AWG to 30 AWG

Differential mode pinout

Table 22. 8-channel differential mode pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	CH0H	Channel 0 HI	28	CH7L	Channel 7 LO
2	CH0L	Channel 0 LO	29	CH7H	Channel 7 HI
3	AGND	Analog ground	30	AGND	Analog ground
4	CH1H	Channel 1 HI	31	CH6L	Channel 6 LO
5	CH1L	Channel 1 LO	32	CH6H	Channel 6 HI
6	AGND	Analog ground	33	AGND	Analog ground
7	CH2H	Channel 2 HI	34	CH5L	Channel 5 LO
8	CH2L	Channel 2 LO	35	CH5H	Channel 5 HI
9	AGND	Analog ground	36	AGND	Analog ground
10	CH3H	Channel 3 HI	37	CH4L	Channel 4 LO
11	CH3L	Channel 3 LO	38	CH4H	Channel 4 HI
12	AGND	Analog ground	39	AGND	Analog ground
13	AOUT0 *	Analog output 0	40	AGND	Analog ground
14	AGND	Analog ground	41	AGND	Analog ground
15	AOUT1 *	Analog output 1	42	+5V	+5V output
16	AGND	Analog ground	43	AGND	Analog ground
	empty			empty	
17	GND	Digital ground	44	GND	Digital ground
18	DIO0	Digital input/output	45	AICKI	AI clock input
19	DIO1	Digital input/output	46	AICKO	AI clock output
20	DIO2	Digital input/output	47	AOCKI *	AO clock input
21	DIO3	Digital input/output	48	AOCKO *	AO clock output
22	DIO4	Digital input/output	49	TRIG	Trigger input
23	DIO5	Digital input/output	50	GND	Digital ground
24	DIO6	Digital input/output	51	CTR1	Counter 1
25	DIO7	Digital input/output	52	CTR0	Counter 0
26	GND	Digital ground	53	TMR	Timer output
27	NC	No connect	54	GND	Digital ground

* RedLab 1608GX-2AO only, other models NC/no connection.

Single-ended mode pinout

Table 23. 16-channel single-ended mode pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	CH0	Channel 0	28	CH15	Channel 15
2	CH8	Channel 8	29	CH7	Channel 7
3	AGND	Analog ground	30	AGND	Analog ground
4	CH1	Channel 1	31	CH14	Channel 14
5	CH9	Channel 9	32	CH6	Channel 6
6	AGND	Analog ground	33	AGND	Analog ground
7	CH2	Channel 2	34	CH13	Channel 13
8	CH10	Channel 10	35	CH5	Channel 5
9	AGND	Analog ground	36	AGND	Analog ground
10	CH3	Channel 3	37	CH12	Channel 12
11	CH11	Channel 11	38	CH4	Channel 4
12	AGND	Analog ground	39	AGND	Analog ground
13	AOUT0 *	Analog output 0	40	AGND	Analog ground
14	AGND	Analog ground	41	AGND	Analog ground
15	AOUT1 *	Analog output 1	42	+5V	+5V output
16	AGND	Analog ground	43	AGND	Analog ground
	empty			empty	
17	GND	Digital ground	44	GND	Digital ground
18	DIO0	Digital input/output	45	AICKI	AI clock input
19	DIO1	Digital input/output	46	AICKO	AI clock output
20	DIO2	Digital input/output	47	AOCKI *	AO clock input
21	DIO3	Digital input/output	48	AOCKO *	AO clock output
22	DIO4	Digital input/output	49	TRIG	Trigger input
23	DIO5	Digital input/output	50	GND	Digital ground
24	DIO6	Digital input/output	51	CTR1	Counter 1
25	DIO7	Digital input/output	52	CTR0	Counter 0
26	GND	Digital ground	53	TMR	Timer output
27	NC	No connect	54	GND	Digital ground

* RedLab 1608GX-2AO only, other models NC/no connection.

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